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Isotypie

A New Half-Tone Process.

Studies of

Count Vittorio Turati,

Milan.

Reprinted from "Process Work and the Printer."

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ISOTYPIE.*

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Reprinted from "Process Work and the Printer."

IN a preliminary communication† the author has given the fundamental rules of "Isotypic" stop images (double stop projections).‡ These will here be circumstantially explained, and practical examples for working described.

The present treatise will not only give a retrospective glance into the system of double projection with cross-line screens, and be a guide to individual Isotypic methods, but its chief view will be to clear up the actual theory —*i.e.*, the fundamental rules of the ordinary half-tone screen process—and to explain them by the aid of experimental researches.

For instance, it is much easier to observe the microscopic projections of two stop openings than it is with a single opening, because in the first case disturbing effects which come into play—for example, the diffraction fringes—still permit us to ascertain with certainty the course of the different phases and forms of the projection, whilst in the second case this can only be done by difficult and not always convincing micrometric measurements.§

The study of the laws governing the images of a double aperture stop give also a clear and sure perception of the effect of single stops as used in the working of the half-tone negatives.¶

From these studies—if their aim is fully attained—an exact and evident demonstration of the screen effect will be forthcoming, clearing up the numerous obscure ideas which prevail at the present day on the results of the single screen apertures (pinhole effects), and so make room for a more accurate conception of the process.

I.

It will now be understood that the point in question is the projection of two stop openings by means of a doubly perforated diaphragm and an ordinary cross-line screen.

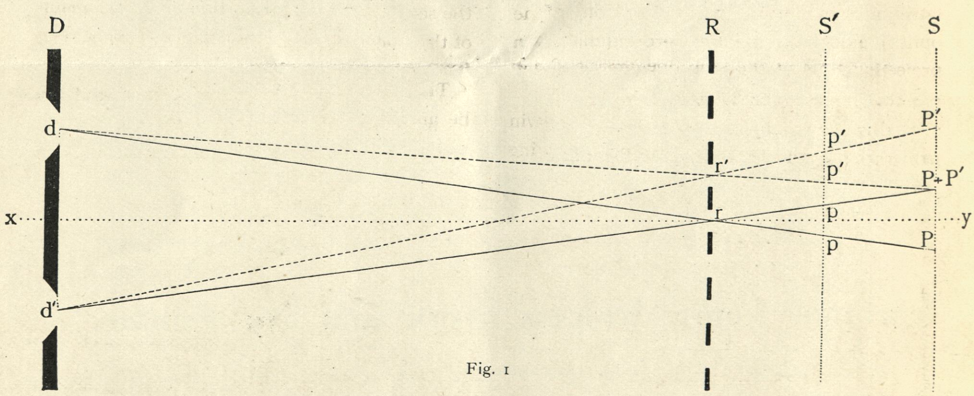


Fig. 1

*"Isotypie"—so called to distinguish it from Autotypie (half-tone)—the new half-tone process of the author. (See also Eder's "Year Book.")

† *Photographische Mitteilungen*, 1875, page 177.

‡ E. Deville read in May 1895, a treatise on "The Theory of the Screen in the Photo-mechanical Process" before the Royal Society of Canada. In this treatise, which was only published at the end of the year, the author treats of similar experiments though undertaken from quite a different point of view.

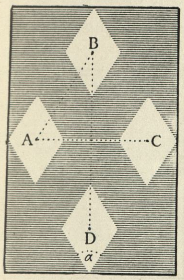
§ For the micrometric estimation of the dimensions of the stop projection those stops are particularly suitable in which the dimension is limited to two small apertures. The projection image of a single stop aperture (as in the ordinary half-tone process is not so suitable, as the margins are not sharp (*i.e.*, vignetted), and therefore not easily definable).

¶ Practical rules for ordinary screen work will be found in an article of the author's, "On the Half-Tone Negative," in the *Photograph. Correspondenz*, 1895, page 507.

Fig. 1 will serve to explain the rules of "Isotypie":

x y = the optical axis of the apparatus,
D = the double stop,
d, d' = the two stop openings,
R = the screen,
r, r' = neighbouring screen apertures,
S, S' = positions of the sensitive plate.

It will be seen that the light-rays *d P* and



F ig. 2.

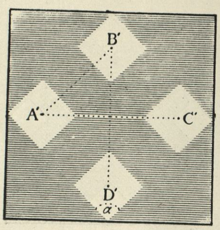


Fig. 3.

d' (*P*+*P'*) which meet in *r* separate again towards the sensitive plate.

If the sensitive plate which stands in the position *S'* is shifted in the direction of the optical axis *x y*, the two projections (twin projections) *p p* of the stop openings *d* and *d'* together, respectively deviate.

Taking now into consideration the twin projections *p'* and *p'* through the neighbouring

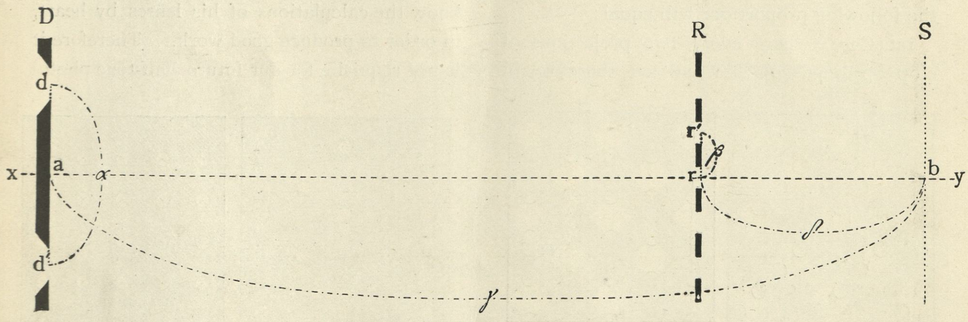


Fig. 4.

screen apertures *r'* it is easy to see that at position *S* of the sensitive plate two projections *p* and *p'* fall together (*P*+*P'*). In this position *S* of the sensitive plate we have thus a number of projections on the plate, according to the number of screen apertures. (This is the first Isotypic case.)

Between *R* and *S*, the double quantity of dots—more or less evenly distributed will be present.

In the middle of *R* and *S*, in *S'*, the projections are evenly distributed, *i.e.*, with even distances from one another.* (This is the second Isotypic case.)

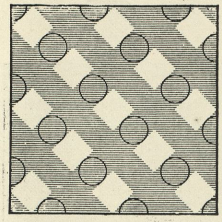


Fig. 5.

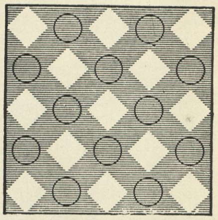


Fig. 6.

It follows generally from the similarity of three angles, for instance *r r'* (*P*+*P'*) and *d d'* (*P*+*P'*), that the distances of the stop apertures *d d'* to the distance of the holes in the screen *r r'* is in proportion to the extension of the camera and to the distance of the screen from the sensitive plate.

This rule is quite valid for practice, and can be amplified by determining for the various ruling of screens the different values (fig. 2).

* It does not agree with mathematical exactness, as this would only be the case if the rays *d P* and *d* (*P*+*P*) laid parallel so that *r r'* (*P*+*P'*) *P* formed a parallelogram, but in reality it is *P* (*P*+*P'*)>*r r'*, and further increase the distance of the projections towards the margin of the sensitive plate. If therefore, for instance, the projections *p p*, *p' p'* . . . . . . in position *S'* (Fig. 1) were in the middle field of the plate at equal distance they will separate more towards the border. Attention is directed to the fact that the real proportions of size, which occur in the camera, and could not be illustrated for lack of space in fig. 1, allow us in practice to regard the bundles of rays *d P* and *d* (*P*+*P'*) as parallel, and the distances and the projections as equal. This fault, which comes also into consideration in ordinary half-tone dot formation, is only noticeable in large sizes of plates) and at short focus; at longer focus it is absolutely without importance. This is especially the reason that for half-tone exposures—and especially for large sizes—lenses of long focus have to be used. Wide angle lenses are by reason of their shorter focus only to be recommended when with a short screen distance a good "closure" (joining-up of the dots) is desired.

AB, AC, BD, which we define as screen normals, being in proportion as

$$1 : 2 \sin\frac{a}{2} : \cos\frac{a}{2},$$

if a is the pointed angle, under which the screen lines are cut.* If on the other hand $a = 90°$, as is the case with the usual cross-line screens (fig. 3) only two values prevail $A'B'$ and $A'C'$ ($= B'D'$), which are in proportion as

$$1 : \sqrt{2}$$

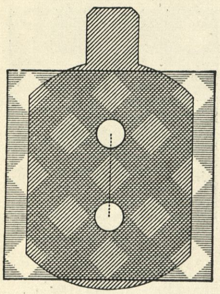


Fig. 7.

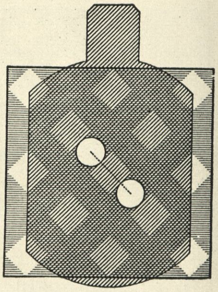


Fig. 8.

Taking the diagram (fig. 4) let

a = the distance, $d\ d'$, of the stop centres,

β = the distance $r\ r'$, of two screen apertures,

γ = distance of stops, $a\ b$, from the sensitive plate.

δ = the screen distance $r\ b$, from the sensitive plate, the latter observed at the position S (see fig. 1),

the following proportions will equal:

1st Case = where every two projections of stop openings coincide and are therefore in

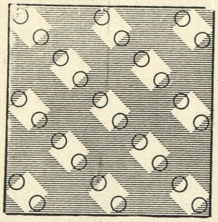


Fig. 9.

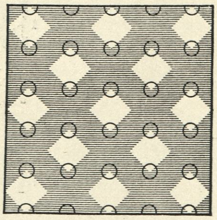


Fig. 10.

equal numbers to the screen apertures (figs. 5 and 6).

For this the following equation applies:

$$a : \beta = \gamma : \delta,$$

when the line joining the stop centres—which we designated as the screen normal—runs parallel with a screen line (fig. 7), but if the

* As a matter of fact this has only value for cross-line screens of regular texture, that is to say where the lines are of equal size and spacing.

stop normals stand to the screen lines at an angle of 45° (fig. 8) this equation holds good:

$$a : \sqrt{2\,(\beta)^2} = \gamma : \delta,$$

2nd Case = where the projections are double the number of the screen apertures and of equal distance (figs. 9 and 10). In this case the sensitive plate is in the position S' (see fig. 1) and the value of δ is halved.

II.

It is important to have a clear conception of these proportions for constructing a corres-

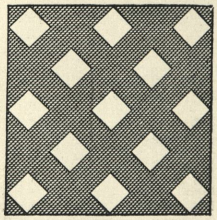


Fig. 11

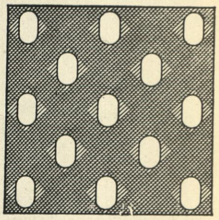


Fig. 12.

ponding stop for a definite projection figure.

Certainly we can in practice attain the result by tedious experiments without resorting to mathematical calculations, and when the data is found and suitable stops constructed, good negatives can be produced by this process. It is quite as unnecessary for the photographer to be acquainted with the scientific foundation of his negatives as to know the calculations of his lenses by heart, in order to produce good work. Therefore it is not requisite for our future half-tone photo-

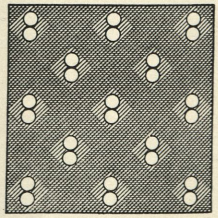


Fig. 13.

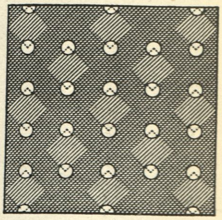


Fig. 14.

graphers—as has been apprehended—to come out of the universities to produce good work.†

† Process Work, October, 1895: "Now that scientific theorists have taken in hand the half-tone screen, there is no knowing where its possibilities are going to end In the *Photographische Mitteilungen* an article has just appeared describing and illustrating some interesting and novel experiments by Count Vittorio Turati in the half-tone process, and as we write, we find this article has been fully translated and published in the November number of the *Process Photogram*. . . . . We must add that we feel quite

The practical description of a safe working method will be entirely sufficient for them. This is also more comprehensible after a microscopic observation of the image on the focussing screen, so that it is possible to work without difficulty in the following manner.

It is understood that the operator is in possession of good apparatus for half-tone work, especially good lenses and good screens. As a matter of course the dark slide should have a mechanism for the movement of the screen.

a powerful focussing eyepiece is used.*

A piece of plate glass on which a cross is scratched with a diamond is put in place of the sensitive plate. The dark slide is then inserted in the camera and the shutter opened. After sharply focussing the cross as is usual when focussing microscopic objects, we observe with the eyepiece the tiny stop projections.

If the stop openings are well illuminated (for instance with a Heliostat or other strong source of light) the double projection on the

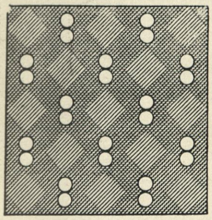


Fig. 15.

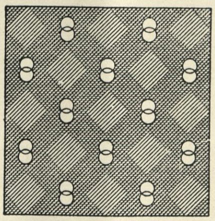


Fig. 16.

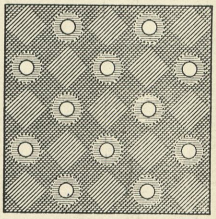


Fig. 17.

When the apparatus is in position make a double stop as shown in fig. 8. This stop is inserted in the lens in such a way that the stop normal and the larger screen normal (B′ D′, fig. 3) run parallel. If, on the contrary, we run the stop normal and the smaller screen normal parallel (A′ B′, fig. 3), the proportions

dark ground is readily recognised, and it is easy to observe how by shifting the screen the dots draw nearer together until they mingle with each other.

When the screen is close to the focussing plate the image of the screen itself is to be seen very sharply (fig. 11).

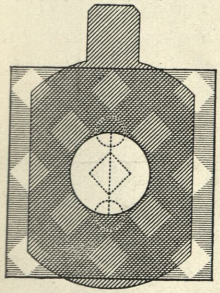


Fig. 18.

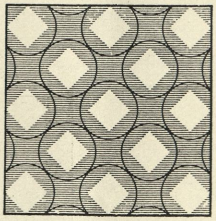


Fig. 19.

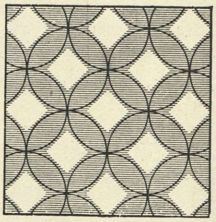


Fig. 20.

are then changed, which will be easily perceived in a certain manner to be taken into consideration in practice.

For the microscopic observation of the screen projections on the focussing plate

If we increase the distance a little, the original sharp and square clear dots commence to take a rounded, vague, and oblong shape (fig. 12), and then to separate at a certain greater distance into two isolated dots (fig. 13)

This distance grows more and more by

sorry for the half-tone operators of the future, if they have to figure out ratios and square root, as a preliminary to every exposure. Perhaps they will feel it about time to take a single ticket for Colney Hatch, leaving their position to be filled by a *fin de siècle* operator, who, if not a senior wrangler, has at least made good running in the mathematical Tripos of our Universities."

* Very suitable for this is the Gaillard Vagus microscope, this little instrument being recommended for its easy handling. [In this country Penrose & Co. have introduced a similar instrument called the Midget Microscope, which is very practical for the purpose — Ed., P.W.]

further increasing the distance of the screen from the focussing plate, until the dots are evenly distributed over the surface (fig. 14).

If the distance of the screen is still further increased the two neighbouring little dots join at last (fig. 15), and those which have not been paired before coalesce (fig. 16) forming a single stronger and apparently greater dot.* (Fig. 17.†)

diameter - *i.e.*, the stop normal (fig. 18)—and put it into the equation.

The first Isotypic case treated above where each two projections coincide, corresponds then with the ordinary half-tone in which two projections join—where, as the practical operator would say, the negative gets "closed."

It may be observed in this case that with different screen normals the projection image,

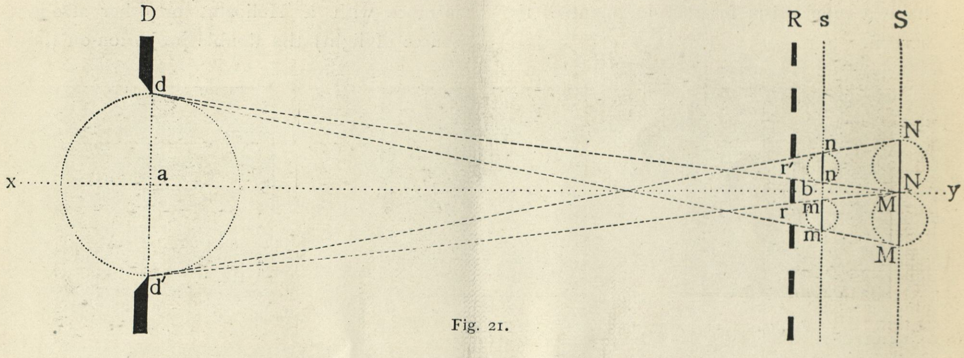


Fig. 21.

Should we wish to obtain on an enlarged scale an idea of the appearances described we may make use of an ordinary photographic camera, with one, or still better, two lenses. Focus sharply a black surface bearing two white discs. The image is received by a second lens and exactly the same appearance as under the microscope will be shown on the focussing screen.

It will hardly be possible—after this elaborate description and easy way of observing the effects of the screen apertures—not to have a clear perception of the theory of the screen, according to which the Isotypie (or half-tone) negative is made by the same effects as produced by pinhole cameras.

III.

The coincidence of the Isotypie with the half-tone rules will be seen from the following.

The mathematical proportions which apply to double stop projections hold good in the same way for the projections of a single central stop of any shape, as we can take for the distance of the stop centres the stop

fig. 19, is applicable (compare fig. 3) for the small normals, and for the larger one the projection image, fig. 20.

The first picture represents the only usefulness of closing up for half tone, the projections leaving on the negatives transparent intervals. The second case cannot come into question because the respective projections join in such a way as to cover one another so that they would form on the negative—as is to be seen

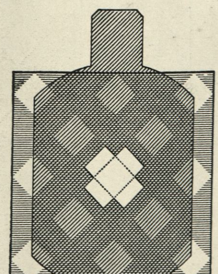


Fig. 22.

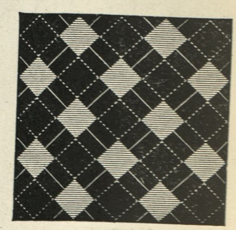


Fig. 23.

from the respective figs.—an uninterrupted black surface.*

* The dot appears large because of its double light intensity.

† If the screen distance is measured by the appearance of fig. 14, and also by the appearance of fig. 17, we find that the latter is double the preceding one. This answers to the equations given.

* This case can be used in practice. It serves very well for easily obtaining greater effect with entirely white surfaces corresponding to covered parts on the negative such as would be ordinarily attained by artificial blocking out. It can be brought about by giving a final exposure (which must be very short) with the screen at a greater distance, or by suitably enlarging the stop diameter.

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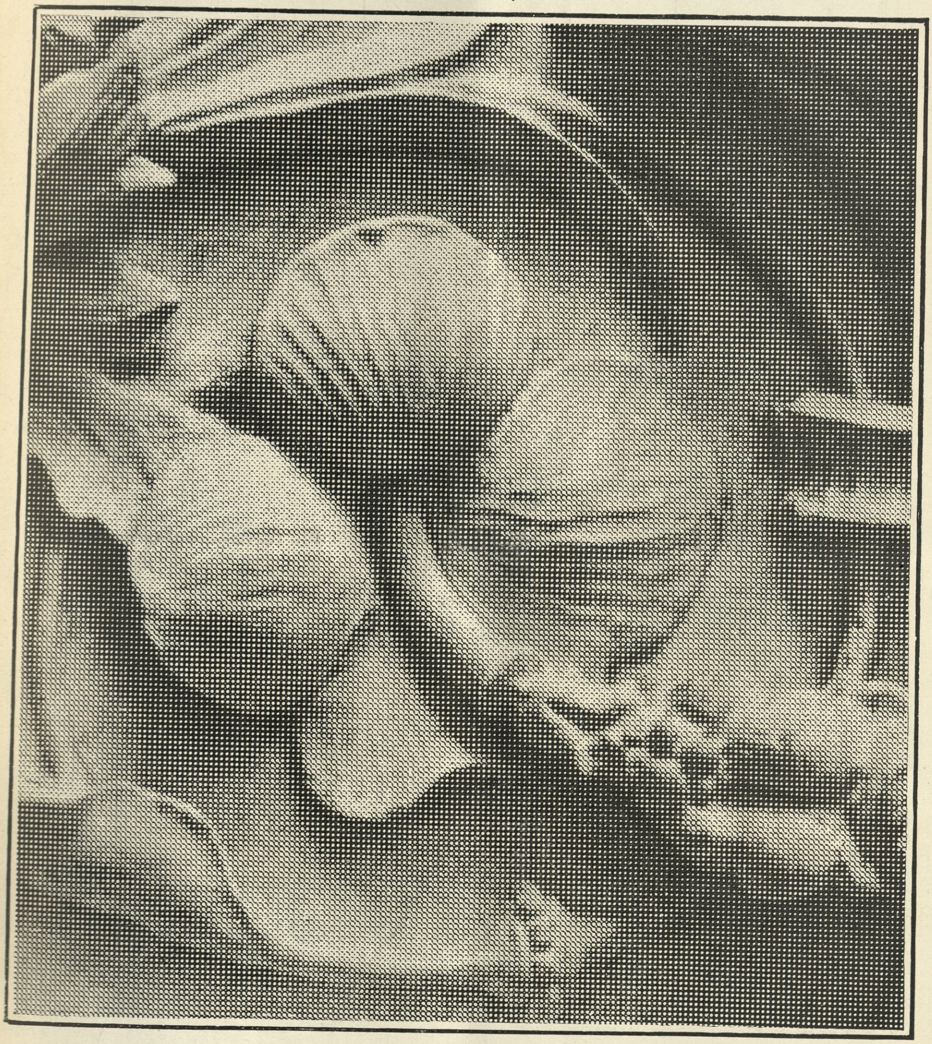

Supplement to the article
"Isotypie"
by V. Turati.

Enlargement
of an
Isotypical Picture.

For first case of closing up the following equation applies :—

$$\alpha : \beta = \gamma : \delta$$

in this as in fig. 4,

α = Stop normals (stop diameter).

β = Screen normal.

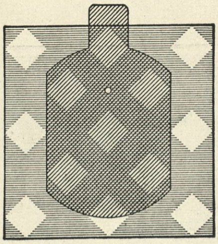

Fig 24.

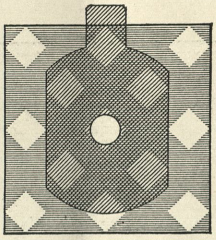

Fig. 25.

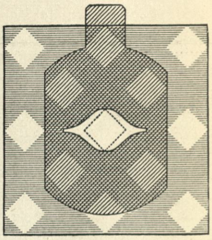

Fig. 26.

γ = Camera extension.

δ = Screen distance.

which is diagrammatically illustrated in fig. 21.

The two projections *MM* and *NN* meet in *MN*. If the plate stands closer to the screen,

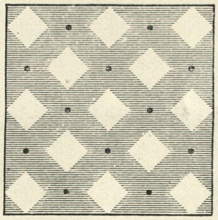

Fig. 27.

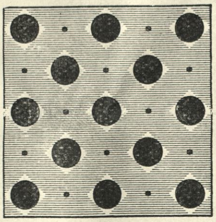

Fig. 28.

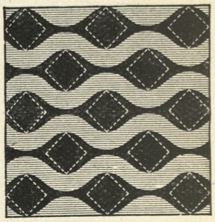

Fig. 29.

for instance at *s*, the projections *mm* and *nn* grow smaller and cannot join at all.

From the similarity of the triangles *dd'* (*MN*) and *rr'* (*MN*) it follows that :

$$dd' : rr' = a\ (MN) : b\ (MN).$$

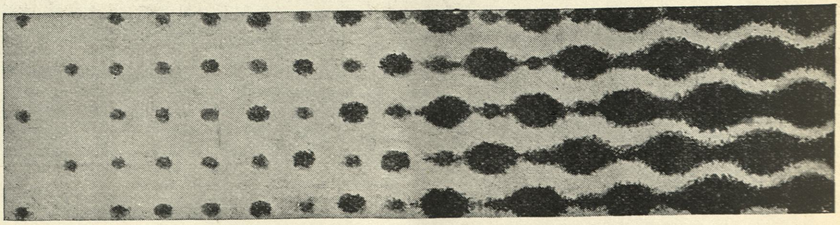

Fig. 30.

If we now seek for an instance—to give the rule a practical application—we find that for a screen of five lines per millimetre (distance between the apertures = 0·2 millimetre), with a screen distance of five millimetres and a camera extension of one metre the exact diameter x of stop requisite to close up will be

$$x : 0{,}1 = 1000 : 5$$

$$x = \frac{1000 \times 0{,}1}{5} = 20\ mm.$$

For this closing up there will be at the same time an appearance of vignetted dots.

Such dots decrease from the middle towards the margin in intensity. The dot has the greatest intensity in the middle, where the point of the cone of rays which proceeds from the stop opening falls on the plate through the screen opening. Here the dot sees, so to speak, the full stop opening, while towards the margin of the dot the active stop opening grows smaller and vanishes towards the border altogether.

This vignetted dot has some importance in half-tone practice. According to the exposure and the intensity of the light respectively it will come out larger or smaller, and we have at hand the means of regulating its size by treatment with iodo-cyanide solution. An

ordinary dot of even intensity, such as is obtained with other distances of the sensitive plate from the screen will reduce only to a certain size, and will then make the dot equally transparent if the reduction is carried further. This would not answer the demands

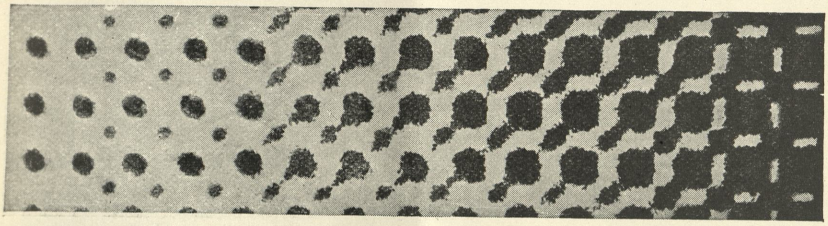

Fig. 31.

of an ordinary half-tone negative, which requires different sized and evenly intense dots, not equal sized and unequally intense dots.

The proportional calculations, easy as they are, will hardly find an entrance into practical

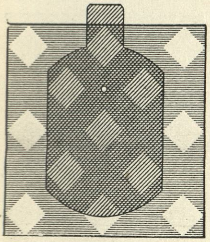

Fig. 32.

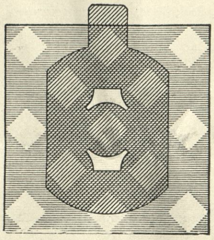

Fig. 33.

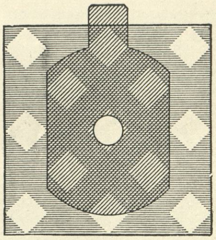

Fig. 34.

work. Therefore the above-mentioned easily performed microscopic determination of screen distance (with the appertaining proportions such as stop opening, etc.,) will be of advantage. The method has already been described

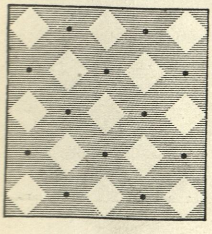

Fig. 35.

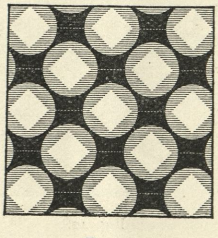

Fig. 36.

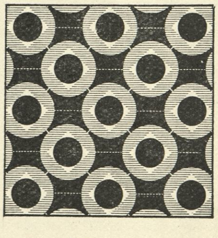

Fig. 37.

in the *Photographische Correspondenz* (1895) and has been brought into prominence under the title of "Focussing the Screen" by Mr. Max Levy, in *The Practical Process Worker*, March issue, 1896, but without mentioning the source of the idea.

As long experience in the studio of the writer has shown, the use of a cross stop (fig. 22*) gives a great advantage and certainty of working for closing up.

The closing up is in this way more easily and nicely attained than by using the round and square stops hitherto recommended.

In the cross stop it is understood that for *a* (stop normal, see fig. 21) we have double the length of the active cross arms, which may be without disadvantage longer, but cannot be made shorter. With this stop there is less danger of veiling the small transparent dots in the high lights.† (See the projection diagram, fig. 23.)

* J M Eder, "The New Collodion Process," page 337.

† We have, through changing different kinds of stops, and by the use of the cross stop, a clear screen formation without veil, so that the troublesome clearing can be omitted. (See *Photographische Correspondenz*, 1895, page 507.)

IV.

The theoretical foundation of the screen effect having been explained, we may follow up with a short and easily comprehensible description of some practical cases.

1. Horizontal undulations in the high lights. For obtaining this effect we make three stops: Figs. 24, 25, and 26, and adjust the screen with the focussing stop (fig. 8) in the first Isotypic case (see fig. 17). This, as described under III., is easily performed with the focussing microscope, and upon the exactitude of focussing depends the success of the negative.

Now we expose with stop No. 1 (fig. 24) on a white cardboard. The effect of this exposure is illustrated in fig. 27.

The foregoing diagrams (fig. 28 and 29) show the effects (projections) of stops Nos. 2 and 3 (fig. 25 and 26) and of course each adds to the image formed by the one before (though for greater distinctness the diagrams are shown as if the exposure had taken place on evenly lluminated surfaces).

These two stops are exposed on the original — No. 2 the longest for the darker tones and No. 3 the shortest for the lights.

Fig. 30 shows the microphotograph of a negative produced in this manner, and of the same size as shown by the projection diagram. This will explain the structure and character of the negative.

The supplement to this article is produced in a similar way, except that the original has been turned 45 degrees in its plane during exposure, and an angular stop has been used, as will be easily recognised by an examination of the enlargement (see supplement) and by the microphotograph (fig. 31).

2. Rings in the lights. This effect is suitable for lessening too strong contrasts in the originals, and requires exactly the same focussing of the screen.

The stops are constructed as in figs. 32, 33, and 34. The preliminary exposure is given with stop No. 1 (fig. 32). With stop No. 2 (fig. 33) we expose on the original a longer

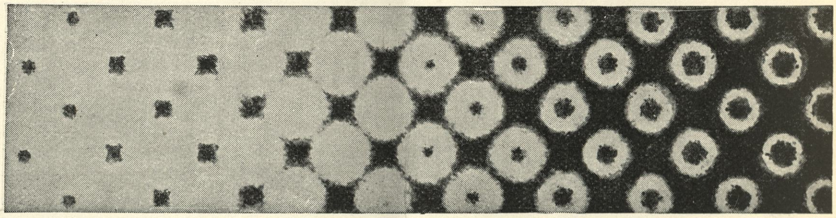

Fig. 38.

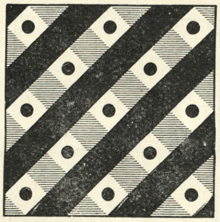

Fig. 39.

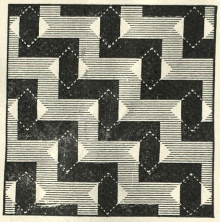

Fig. 40.

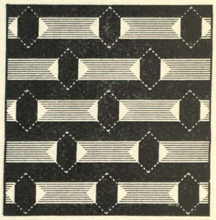

Fig. 41.

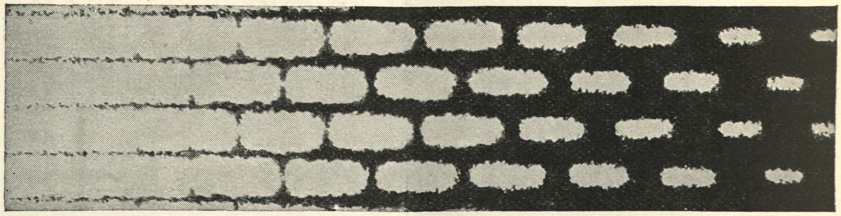

Fig. 42.

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time, until all the detail—after developing—is recognised. The highest lights, which would still show two large round, transparent dots, are corrected by a short exposure with stop No. 3 (fig. 34), which inserts in the middle of these transparent dots small opaque dots, so that in the lights of the negative transparent rings are forthcoming.

The effects of these combinations will be

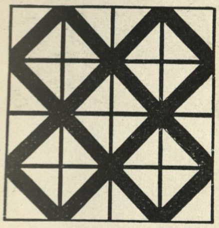

Fig. 43.

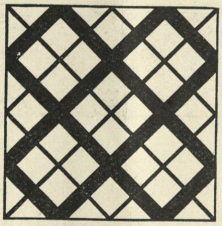

Fig. 44.

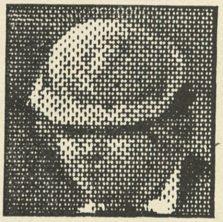

Fig. 45.

comprehensible from the diagrams figs. 35, 36, and 37, and from the microphotograph (fig. 38).

Other combinations—as shown for instance in figs. 39, 40, and 41, and the microphotograph (fig. 42)—may be made in great variety.

A clever operator will quickly master the difficulties as to right exposure and treatment of the negatives.

As with everything else, practice is the best instructor. Whoever has once penetrated into the essence of the tiny picture-elements will learn quickly how to master them. As a matter of fact there is no better school for the half-tone photographer than to occupy himself with a study of it. Thereby he acquires for the treatment of the ordinary half-tone dots a sharper judgment and is not so dependent on the whims of a half comprehensible process.

It may here also be mentioned that effects similar to Isotypie can be produced in a totally different way.

Levy has taken out a patent for a particular kind of screen,* which, instead of having equal spaces, consists of alternately thick and thin lines. Such screens and the effect to be obtained with them are to be recognised in the strong enlargements (figs. 43, 44, and 45).*

All this, and much more, can as shown be obtained by the author's method, without requiring expensive screens, and an unlimited variety of shapes secured.

Another method of Isotypie dot formation is the use of two screens, with different proportions which are changed during exposure or shifted one over the other.

But such screens impose exceptional demands on the makers and their machinery, and the smallest mistake or the minutest shifting in a wrong direction would spoil the result.

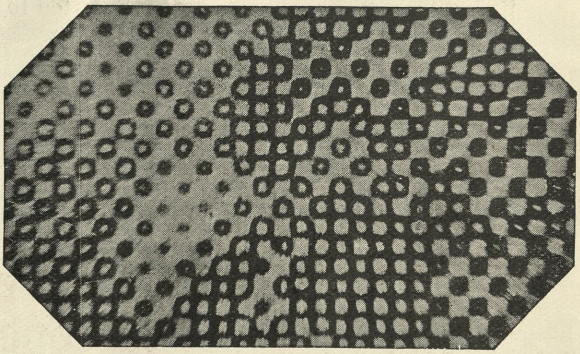

Fig 46.

The final picture (fig. 46) shows a microphotograph of a formation produced in a physico-chemical way, but which has no value in practice, and has only been produced as a curiosity.

* *Photographische Mitteilungen*, page 827, 1896, and *Atelier der Photographen*, etc

* The screens (figs. 43 and 44) are drawn from Eder's Year Book. Fig. 45 is a direct enlargement from the respective supplement.

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